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The Effects of Listener and Speaker Training on Emergent Relations in Children With Autism

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The current study assessed the use of standard conditional discrimination (i.e., listener) and textual/tact (i.e., speaker) training in the establishment of equivalence classes containing dictated names, tacts/textual responses, pictures and printed words. Four children (ages 5 to 7 years) diagnosed with autism were taught to select pictures and printed words in the presence of their dictated names, and to emit the tact or textual response corresponding to a presented picture or printed word. Both speaker and listener training resulted in the formation of stimulus classes for 3 of 4 participants.

Key words: stimulus equivalence, naming, speaker, listener, autism

It is only within the past two decades that research on stimulus equivalence has been extended into teaching procedures targeting individuals with autism (e.g., Keintz, Miguel, Kao, & Finn, 2011; Miguel, Yang, Finn, & Ahearn, 2009). In these studies, participants were trained to select pictures and printed words in the presence of their respective dictated names, and then tested on whether they could match pictures to printed words and vice versa. Additionally, participants responded similarly to all stimuli showing functional equivalence. These novel relations have been termed *emergent* or *derived*.

Some researchers have argued that emergent relations are dependent upon participants' verbal skills (Horne & Lowe, 1996). In other words, stimulus equivalence can only be obtained when class members produce the same speaker and listener behavior (i.e., naming). A series of studies have shown that when typically developing children have naming, they can pass equivalence tests (e.g., Lowe, Horne, Harris, & Randle, 2002; Miguel, Petursdottir, Carr, & Michael, 2008). One of the few naming studies conducted with children with autism, Eikeseth and Smith (1992) showed that participants who initially failed emergent relations tests after being trained on receptive discrimination, were able to do so after learning to tact the stimuli with common names. These results imply that receptive discrimination training (i.e., listener) may only produce emergent performance when participants can also tact the stimuli (i.e., speaker). Conversely, tact training may also be sufficient to establish equivalence classes, as long as participants can also receptively discriminate stimuli (Miguel et al., 2008).

Clinically, if tact training is sufficient to establish equivalence classes, then for a child to comprehend that the printed words ''apple,'' ''pomme,'' and a picture of an apple have the same meaning, it may be possible to simply teach her to label all these stimuli as ''apple'' (Miguel & Petursdottir, 2009). Comprehension would then be measured by assessing whether words and pictures are substitutable for one another in a matching-to-sample task (Sidman, 1994). Although most studies have produced equivalence classes via receptive discrimination, no studies conducted with children with autism have assessed the formation of equivalence classes via speaker behavior alone. Thus, the purpose of the current investigation was to assess and compare the use of standard conditional discrimination (listener) and textual/tact (speaker) training in the establishment of equivalence classes containing dictated words, pictures, and printed words with children diagnosed with autism.

METHOD

Participants, Setting, and Materials

Four children diagnosed with autism participated in the study: Sam (7 years),

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Eric (7 years, 9 months), Darren (5 years, 11 months) and Daniel (5 years, 11 months). They had echoic repertoires, could complete matching-to-sample tasks, and tact a minimum of five items/pictures. Sam and Eric had beginning textual skills (e.g., selected printed words based on the first letter of each word), while Darren and Daniel did not. Sessions were conducted in a specific room in each participant's home or school environment. Consequences used during these sessions were selected via a brief multiple stimulus preference assessment without replacement (MSWO; Higbee, Carr, & Harrison, 2000) conducted prior to each session. One to six nine-trial blocks were conducted daily, 2 to 5 days per week. The experimenter sat at a table next to the participant and presented all tasks on a stimulus board. The board was made of a poster board material (43.18 × 17.78 cm). One strip of Velcro, measuring 2.54 cm was adhered to one side of the board for the purpose of holding cards in place. Experimenters were trained to avoid looking directly at the participant's face, as well as the stimuli. For Sam and Eric, nonarbitrary stimuli were used, while for Darren and Daniel arbitrary stimuli were used. For Sam and Eric, printed words were presented in Spanish, while corresponding dictated names were presented in English to ensure that selections were made based on training, rather than as a result of beginning reading skills demonstrated by these two participants. Table 1 shows stimuli and condition assignment for participants. Visual stimuli were 7.6 × 12.7 cm with line drawings, photos or printed words (36 pt, Times New Roman font).

Response Measurement, Interobserver Agreement, and Treatment Integrity

Dependent measures were percentage of independent selections of the correct comparison from a three stimulus array, and the percentage of independent correct vocal responses in the presence of pictures and printed words during pretests and posttests. Secondary dependent measures included the number of trials to criterion and the number of errors. Interobserver agreement (IOA) was calculated by dividing the number of agreements by the sum of agreements plus disagreements multiplied by 100. IOA was collected on an average of 60% of blocks across participants (range 43% to 76%). IOA averaged 98.35% across participants, with average IOA per participant as follows: Sam – 98% (range 77%–100%), Eric – 99.9% (range 94%–100%), Darren – 97% (range 89%–100%), Daniel – 98.5% (range 89%–100%). Treatment integrity (TI) data assessed whether experimenters presented the correct discriminative stimulus, appropriately randomized the placement of stimuli on the stimulus board, adhered to the prescribed prompt, and appropriately delivered reinforcement. TI data were calculated by dividing the number of correct trials by the total number of trials multiplied by 100. TI data were collected on an average of 33% of trials across participants (range 0% to 51%), and averaged 96.7% overall, with the following average per participant: Sam – 98% (range 83%–100%), Darren – 95% (range 94%–100%), Daniel – 97% (range 78%–100%). TI was not collected for Eric as his sessions were not videotaped, per parent request.

Research Design

An alternating-treatments design in which a different stimulus set was assigned to each condition was used for assessing the effects of speaker and listener training, with speaker and listener training implemented simultaneously. Additionally, a pretest-posttest design was used to measure the emergent relations.

Procedure

Training. Participants were taught listener relations in the following order: (1) AB (i.e., the selection of picture [B] in presence of dictated name [A]), (2) AC (i.e., the selection of the printed word [C] in the presence of the dictated name [A]), and (3) mixed trials of AB-AC. During each trial, the experimenter waited until participants demonstrated readiness as defined by sitting up straight with feet on the floor, hands either folded on table, in lap, or by sides and were making eye contact with experimenter before presenting the sample stimulus. Following the demonstration of readiness by the participant, eye contact was removed and the auditory sample

Table 1
Stimulus Sets for Each Participant

	Set 1			Set 2		
Participant	A	B	C	B	C	D
Sam	"grinder"		Muela		Cucharon	"ladel"
	"juicer"		Exprimidor		Pinza	"tongs"
	"processor"		Robot de cocina		Latigo	"whip"
Eric	"ladle"		Cucharon		Muela	"grinder"
	"tongs"		Pinza		Exprimidor	"juicer"
	"whip"		Latigo		Robot de cocina	"processor"
Darren	"chey"		Chey		Voggy	"voggy"
	"boosha"		Boosha		Wak	"wak"
	"ono"		Ono		Heeny	"heeny"
Daniel	"voggy"		Voggy		Chey	"chey"
	"wak"		Wak		Boosha	"boosha"
	"heeny"		Heeny		Ono	"ono"

A – dictated name (by experimenter), B- picture, C- printed word, D- spoken name (by particicpant).

presented. After presenting the sample, the comparisons were laid out in front of participants in a three stimulus array. Each positive comparison appeared once in each position (left, middle or right) in a nine-trial block. Initially, participants were provided with a point prompt following the delivery of the stimulus (dictated name), with the prompt progressively delayed by 1 s per step (i.e., 0 s, 1 s, etc.), so that step 1 had a 0 s delay, step 2 had a 1 s delay and so on until step 6, in which there was no prescribed prompt, and participants were required to respond independently within 5 s. The criterion to increase the delay was two consecutive nine-trial blocks with at least eight of nine

correct responses (89%). The criterion to decrease the delay was three consecutive incorrect responses within one nine-trial block. Incorrect responses resulted in the experimenter representing the trial with an immediate prompt.

During speaker training, participants were taught relations in the following order: (1) BD (i.e., to label the picture [B]), (2) CD (i.e., to read the printed word aloud), and (3) mixed BD-CD (i.e., trials of BD and CD relations were interspersed). The sample stimulus card was initially held with the back facing the participants (i.e., blank side of card presented). After participants looked directly at the blank card for 1–2 s, the card was reversed (i.e., visual stimulus was presented), and the experimenter asked, ''What is it.'' An echoic prompt was immediately given and then progressively delayed by 1 s, as with listener training. Criteria to increase or decrease the prompt delay were identical to listener training.

A differential reinforcement procedure was implemented following the first independent response made by each participant (Karsten & Carr, 2009). Once participants responded correctly in the absence of prompting, independent responses were followed by the delivery of the primary reinforcer, while prompted responses were followed by praise. When participants responded correctly prior to the delivery of the prescribed prompt for at least eight of nine trials across two consecutive blocks, they immediately progressed to step 6 (i.e., independent responding), in which no prompt was provided.

Testing. Pretests and posttests were conducted for three types of relations: (a) visual-visual matching (i.e., BC and CB), (b) auditory-visual matching (i.e., AB and AC), and (c) oral labeling, including tact (i.e., BD) and textual (i.e., CD) behavior. Pretests and posttests for visual-visual tasks (i.e., BC and CB) were completed after both listener and speaker training. Auditory-visual matching (i.e., AB and AC) pretests and posttests were completed for relations taught via speaker training, and oral labeling pretests and posttests were conducted for relations taught via listener training. For visual-visual matching tasks (relations BC and CB), participants matched pictures to printed words and vice versa. For these tests, the experimenter presented either a picture (B) or a printed word (C) as a sample and following the observing response made by the participant (i.e., touching sample), provided the instruction, ''match'' and required the participants to independently select the positive comparison from a three stimulus array. For auditory-visual tasks, participants were required to independently select the positive comparison picture (B) or printed word (C) from a three-stimulus array when presented with the dictated name (A). During tact and textual relations tests, the sample stimulus card was initially held with the back facing the participant (i.e., blank side of card presented). After participants looked directly at the blank card for 1–2 s, the card was reversed (i.e., visual stimulus was presented), and the experimenter asked ''What is it.'' For tact and textual relations, participants either tacted a picture or read a printed word (textual behavior), respectively. Across all trial types, the experimenter waited 5 s for the participants to respond. Neutral social feedback (i.e., ''ok'') was delivered for all responses during testing, regardless of accuracy, with each relation tested in nine-trial blocks (LeBlanc, Miguel, Cummings, Goldsmith, & Carr, 2003). Trials of previously mastered tasks (e.g., instruction following) were interspersed every two to three testing trials to ensure continued responding by participants. For all participants, posttests were completed following mastery of trained relations in both conditions (i.e., speaker and listener).

A second pretest was completed if, during the first pretest of any given relation, scores were above chance level. This second pretest was conducted immediately following the first pretest. A second pretest was completed for at least one relation for Sam, Daniel, and Darren. A second posttest was completed for visual-visual tasks (i.e., BC and CB) for Daniel only. This posttest occurred after posttests of all other relations had been completed. This second posttest assessed for delayed emergence, and was implemented as Daniel demonstrated emergence of all other untrained auditory-visual (i.e., AB and AC) and tact (i.e., BD) and textual (i.e., CD) relations.

Table 2
Trials to Criterion and Errors During Listener and Speaker Training

	Trials to criterion		Total errors	
Participant	Listener	Speaker	Listener	Speaker
Sam	288	243	40	25
Eric	324	243	25	8
Darren	207	207	1	3
Daniel	270	279	8	15

RESULTS AND DISCUSSION

All participants successfully acquired listener relations in an average of 272 trials (range 207 to 324); and speaker behavior in an average of 243 trials (range 207 to 279). Table 2 contains the number of trials to criterion and number of errors made by each participant and teaching procedure. Of the four participants, only Daniel acquired listener relations in slightly fewer trials than speaker relations. He required 270 and 279 trials to acquire listener and speaker relations, and made 8 and 15 errors, respectively. Darren acquired listener and speaker relations in exactly the same number of trials with almost no errors (see Table 2). The remaining participants, Sam and Eric acquired speaker relations more rapidly than listener. Sam and Eric required 288 and 324 trials, and made 40 and 25 errors, respectively during training. Conversely, they both learned speaker relations in 243 trials and made 25 (Sam) and 8 (Eric) errors.

For all participants, both listener and speaker training resulted in the formation of stimulus classes. During pretesting of emergent relations (see Figure 1), all participants scored at or below chance levels, with the exception of Darren's first pretest scores for the AB relation (55%), and Daniels' pretest scores for the BC relation (55%). A second pretest for these relations revealed inconsistent positive selections; 44% and 11% for Darren and Daniel, respectively. During posttests, participants also matched pictures to printed words and vice versa (relations BC and CB, respectively) reliably following speaker training. While Daniel made some errors during the posttest of the CB relation (67%), a second posttest revealed perfect performance (100%). Conversely, listener training did not consistently result in the emergence of speaker behavior across participants. Sam scored only 33% on the CD relation (textual), and 67% on the BD. Because of the relatively high percentage of correct responses during the BD relation as compared to baseline (0%), it is possible that a second posttest for this relation would have revealed full emergence. Listener training also resulted in the emergence of picture and printed word matching for three of four participants; Eric, Darren and Daniel matched pictures and printed words following listener training, but Sam did not. While scoring 89% on the BC relation, Sam scored 55% on the symmetrical CB relation.

While listener training did not necessarily lead to the emergence of speaker skills and the formation of equivalence classes, every time the speaker relation was taught, the emergence of both listener skills and equivalence was observed. It is possible that, during speaker training, when participants were required to attend to the stimulus, and produce a vocal response, that the auditory stimulus produced by their response may have acquired discriminative control over orienting toward the picture, which is a form of listener behavior. These data support previous research that suggests that speaker behavior is more likely to produce listener behavior than vice versa (Petursdottir & Carr, 2011) and that both skills may be related to success in emergent relations tests (Miguel et al., 2008). An important limitation is that Sam was never exposed to a second posttest to assess for delayed emergence. However, Sam had perfect scores on the first posttests after speaker training but not after listener training, suggesting that speaker training was superior in producing emergent relations.

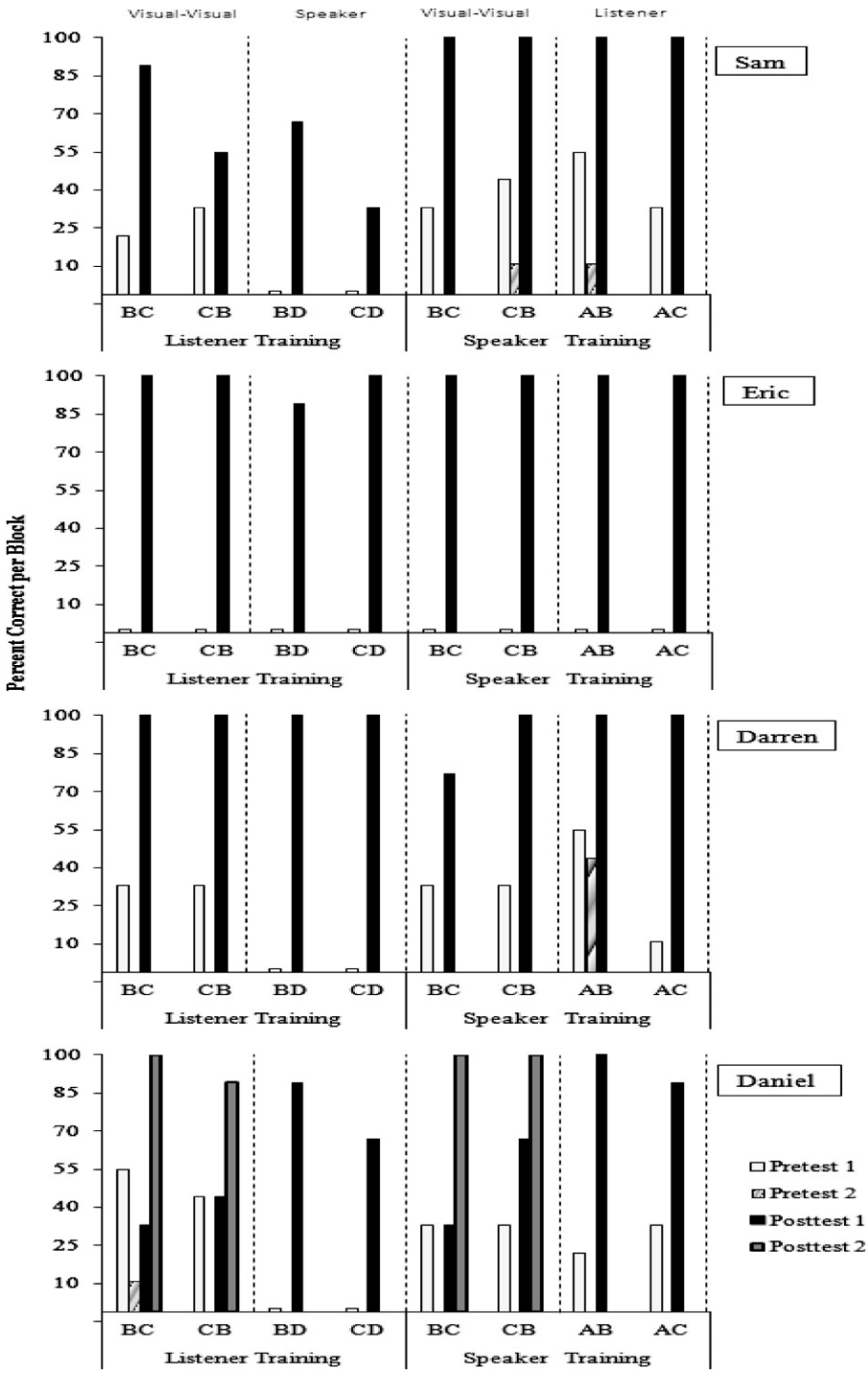

Figure 1. Pretest and posttest scores for emergent relations after both Listener and Speaker training across participants.

Clinically, speaker (tact and textual) training seems to be a viable alternative for learners who have failed to demonstrate novel stimulus relations via conditional discrimination training.

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